Annals of the Forty Four Club

1844 - 1914

ANNALS
OF THE
FORTY FOUR CLUB

SEVENTY YEARS 1844-1914

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Reunion of the "Forty Fours"

THE first regular meeting of this Club which has no constitution or by-laws, no President, Secretary or Treasurer, was held at the residence of Hon. J. R. Leeson, upon his invitation, December 2, 1914—present, Mr. Leeson, Arthur C. Walworth, David H. Andrews and W. E. Huntington. After a sumptuous dinner of vegetables grown on the estate, and other courses produced by the rare skill of Mr. Leeson's culinary chief, the Club spent a delightful hour or two in congenial chat, and in a sketchy review of some important things that have happened during the seventy years since 1844.

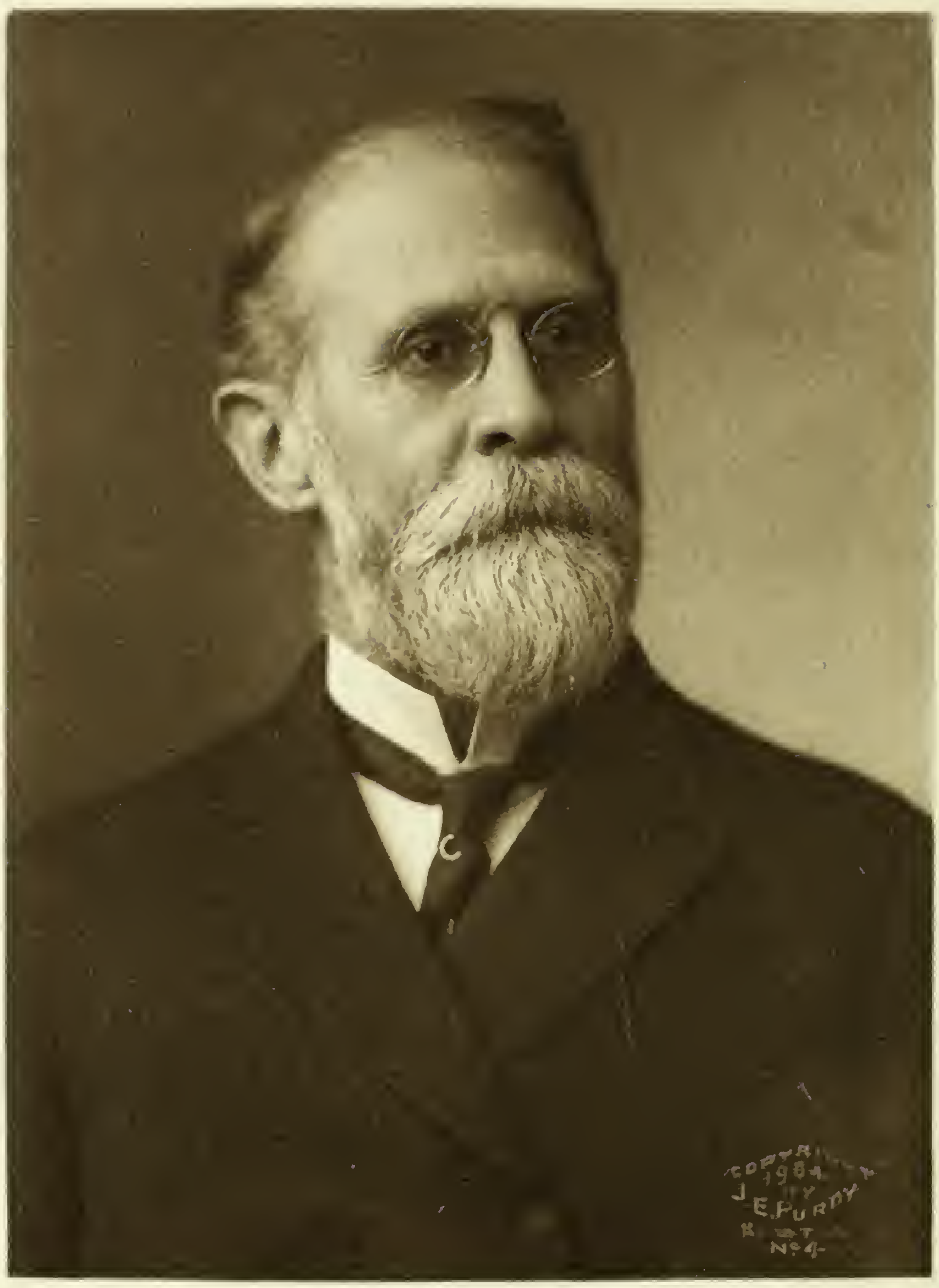
This review, by Mr. Leeson's request, was conducted by Messrs. Walworth, Andrews and Huntington. Mr. Walworth outlined the

progress that has been made in the mechanical world; Mr. Andrews traced the growth of engineering; Mr. Huntington gave some of the main facts in the advance of education. These contributions are, at Mr. Leeson's suggestion, put into type-written form, and are the first chapter in the *Annals of the Forty-four Club.*

W. E. H.

Mr. J. R. Leeson.

Elgin Villa.
Newton Centre, Mass.



William Edwards Huntington,
July 30, 1844.

Education in the United States Since 1844

IT is difficult to compress within the limits of a brief sketch even the main facts in regard to the advances made in education during the last seventy years. At the middle period of the nineteenth century the common school system was well established as a national organism; but school buildings, especially in rural districts, were small and poorly equipped, only elementary studies were taught, school books were not attractive in content or form, illustrative materials, such as maps, charts and apparatus, were of the simplest kind, or else—as was often the case—entirely lacking.

Colleges were then scarcely more than what the best High Schools are to-day; in fact, in scope of instruction, thoroughness of drill, facilities for scientific study, the College of seventy years ago was inferior to our best High Schools. Harvard and Yale were then

small Colleges. The total number of students in either of these Colleges in 1844 was not equal to the number of Freshmen entering in 1914. My own class that was graduated from the University of Wisconsin in 1870 numbered seventeen. In June, 1914, this University turned out from all its departments over five hundred graduates.

The vast expansion and enrichment of educational opportunities in this country, especially since the close of the Civil War, has been the marvel of all the world. It may well be claimed that as our nation has increased in material prosperity, the advance of educational institutions and their equipment has kept pace with the growth of wealth. This has been accomplished because of far-sighted and devoted leaders, both in our national councils and in the separate states.

Two men of marked distinction may stand as types of educational leadership. Horace Mann, in our own Commonwealth, was a powerful force in giving to Massachusetts a public

school standard that has not been surpassed in any of the states. He was the son of a small farmer of Franklin County, was a graduate and then an instructor of Brown University, studied law in Litchfield, Connecticut, and practised law for a time in Dedham, became a member of the Massachusetts Legislature, and debated, with earnestness and intelligence, all important public questions. Of high moral standards in his own character, he entered cordially into every movement for the elevation of public intelligence and morality. He became Secretary of the State Board of Education at the time of its organization in 1837, and from that date he threw himself heart and soul into the work of recasting the entire school system. Under his leadership Normal Schools were established, educational institutes, or conventions, were introduced, school registers showing the actual conditions of the schools were kept, and from these data he brought out his annual reports which were looked upon as standards in matters of edu-

cational opinion. About the year that the members of this Club were born Horace Mann visited Europe at his own expense, gathered information on School problems at various seats of learning in the Old World, and afterwards published this store of knowledge in a volume which went through many editions. In the history of the part Massachusetts has taken in the development of the best principles of education, Horace Mann's achievements were of noteworthy importance.

In a still larger field of influence William T. Harris, who was born in Connecticut nine years previous to the date so sacred to this Club, was a distinct force in the national scope of our public school system. He began as a teacher in the schools of St. Louis, Missouri, in 1848; became Superintendent of the City Schools in 1868, and held this post for many years. In 1889 he was appointed Commissioner of Education for the United States. For many years he was editor and chief contributor of the "Journal of Speculative Phi-

losophy" which he established. In this Journal he was the very able expounder of Hegel's philosophy, and the translator of important papers from Leibnitz, Descartes, Kant, Fichte and Schelling. He also contributed to the magazine remarkable articles on art. In 1899 the University of Jena gave him the honorary degree of Doctor of Philosophy for his work on Hegel. His philosophic mind, his wide grasp of the best theories of education, his facility in expressing the results of his pedagogical learning and experience in excellent literary form, made his Reports as Commissioner a national contribution to the advancement of the general cause of education. Dr. Harris established while in St. Louis the first permanent public-school kindergarten in the United States. On his retirement from the Commissionership in 1906, the Carnegie Foundation for the Advancement of Teaching conferred upon him "as the first man to whom such recognition for meritorious service is given, the highest retiring allowance which our

rules will allow, an annual income of $3,000."

If we turn to the rank of Collegiate and University institutions, and their development in the past seventy years, we are surprised to find that of the five hundred and more higher institutions now in existence in the United States over four hundred were established since 1844. This astonishing multiplication of Colleges indicates the widespread purpose among the American people to give the best possible facilities to the oncoming ranks of youth for an ample equipment in mental discipline to meet the tasks before them.

It must be confessed that Colleges and Universities of highest rank are few; and that there is a long list of institutions of slender foundations and meager equipment, that ought not to be ranked above academies, and which nevertheless grant College degrees. The hope is, of course, that the poor ones will become rich, and outgrow the limitations that poverty has imposed.

A few great endowments have come to some

of the conspicuous Universities within the last twenty-five years. Leland Stanford, Jr., University in California and the University of Chicago have been the two institutions that have been most munificently endowed by private benefactions of many millions. For the past forty years some of the State Universities have received bountiful grants from the State Legislatures—Illinois, Michigan, Wisconsin and Minnesota being among those most favored by such subsidies. But, beyond the range of these great institutions, scores of Colleges and Universities have been gathering in noble endowments, witnessing to the great generosity of the people who are thus fostering the intelligent powers of the Republic.

One of the great features of educational advancement since the time of the opening of our Civil War was the establishing by what is known as the Morrill Act of Congress of the Agricultural Colleges of the United States. By this act a large land grant was given to each state for the support of the Agricultural Col-

leges that should be established. The object of the American Agricultural College was: 1. To promote the business and social welfare of the farmer through courses of study and by means of appropriate dealing with the materials of his life and surroundings. 2. To insure the development of agriculture beyond the confines of handicraft and into the field of science, not as a favor to farmers, but as a matter of general and public welfare. 3. To preserve the homogeneity of the American people by making it unnecessary to desert the farm and the shop in order to secure the benefits and graces of education. No event in our educational history is so remarkable as the rise and development of agricultural education. While the nation was somewhat slow in furnishing the necessary means to carry out the original purpose of such an institution, the recent developments of agriculture and of the Experiment Stations have induced the government to appropriate large sums of money for a successful work to be done in

these agricultural centers. The latest data at hand show that $20,000,000 was recently appropriated to carry on the work of the Agricultural Colleges and Experiment Stations.

The following are some of the main features of the Agricultural Department of the United States:—

1. The Weather Bureau is under the direction of this department.
2. The Investigation Bureau of Animal Industry.
3. The Bureau of Soils which deals with the Chemical and Biological make-up of soils.
4. The Forest Service which is responsible for developing the American Science of Forestry.
5. The Bureau of Plant Industry.
6. The Bureau of Chemistry which applies in its investigations the Science of Food Adulterations.
7. Bureau of Entomology.

8. Biological Service which deals with the migration of birds.
9. Bureau of Statistics.
10. Office of Public Roads.
11. Office of Experiment Stations.

It is a remarkable fact that the Department of Agriculture which began its most important work as early as 1858, but was greatly stimulated by the work accomplished through Senator Morrill of Vermont, launched the scheme for establishing Agricultural Colleges in all the states in the early period of the Civil War, in 1862. It is felt that a close sympathy exists between the great American public schools and the state institutions, thus welding the common interests of our people into a noble unity. Those who are expert in this line of education think the following influences from land-grant colleges, as they are called, may be noted:—

1. A greatly stimulated interest of the people in higher education.

2. The debates incident to the passage of the land-grant act have set a precedent and proved the wisdom of Federal aid to education.

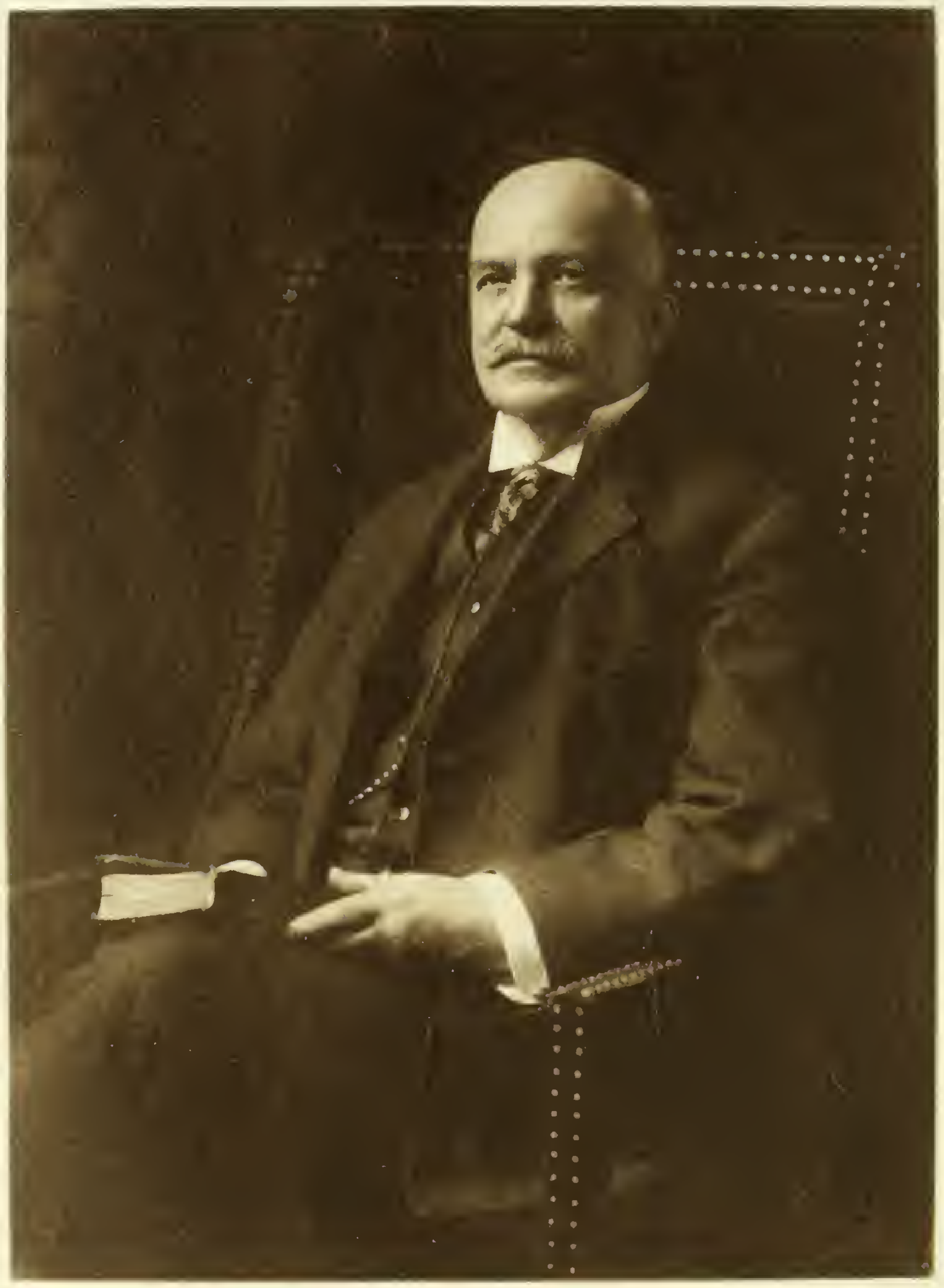
3. The experience and history of these colleges have brought industrial education to a place of esteem among the American people and have forced its recognition by all institutions for higher education.

4. Agricultural Colleges have influenced the practical aims of higher education.

5. They have stimulated investigation and research in many fields.

6. The establishing of these institutions has had an influence upon the government itself which has become more and more humane, beneficent and philanthropic in its activities.

William E. Huntington.



Arthur C. Walworth.

April 29, 1844.

Seventy Years

1844—1914

IT is a remarkable fact that no period of seventy years in the world's history can be named that covers as much material and scientific progress as that of 1844-1914.

In the time of our lives which seems so brief to us as we look back, the whole face of civilization has been changed. 1844 was the twilight of a new day of invention and material progress; perhaps 1914 is high noon, for science is advancing yet with rapid steps and seems now to be pressing across the boundary between the known and the unknown. Already the old definitions of matter and spirit are obsolete; what our grandchildren may see and know, who can say?

The writer, the oldest of "us four," was born on the 29th of April, 1844. On that day James K. Polk sent his "profession of

faith" to the Democratic Convention at Baltimore, which later gave him the nomination; this was the custom in those days, and not a bad one. At that date, steamboats had just begun to be a factor in travel and railroads were in their infancy, for the first of them out of Boston were completed in 1835. The electric telegraph, invented by S. F. B. Morse in 1840, was not yet in use. In 1845 came the Hoe cylinder press, making the modern newspaper possible. In 1846 Elias Howe patented the sewing machine.

At that date, my father's store and machine shop was at No. 18 Devonshire Street, where the building designated as No. 54 now stands; the firm was "Walworth & Nason," established in 1841, the first in the U. S. to make and sell steam-pipes, valves and fittings. Right across the street was a machinist named Baker. Elias Howe ran the engine at our shop, the family living in a large house still standing in Cambridgeport. Howe was an ingenious cuss and spent his spare time in

making a machine that would sew. At last he hit the vital idea of putting the eye next the point of the needle, the key of the invention. Not until his patent on this device expired, could any one make or sell a sewing machine without paying him a royalty. He showed his crude contraption to Baker, across the street, who became interested and helped him develop his first machines. Later Mr. Baker associated himself with a Mr. Grover and the firm of Grover & Baker began to make machines. In 1854 Mr. Nathaniel Wheeler of Bridgeport invented a "four motion" feed for sewing machines, while Howe invested his royalties in a large factory in Bridgeport. Howe, Baker and Wheeler all became very wealthy. That eccentric Baker, who had a very strange estate in Needham, was a son of this old Baker and he was paid a salary to keep away from the factory. The cost of sewing machines has fallen from $100 to $17 in the fifty years of their use. My father bought a "Grover & Baker" in 1854.

The neighbors came in to see it operated by my mother.

About this time Prof. Morse was having a hard time to get his telegraph tested and at last he obtained a small grant from Congress to build an experimental line from Washington to Baltimore.

Every one who has seen a steam boiler or apparatus has probably noticed a dial like a clock, with an index hand. This is the steam gauge invented by Bourdon, a Frenchman, in 1849. They used to cost from $50 to $100. They are now required by law and may be bought for $1.50.

About 1852 the fire alarm telegraph was invented and first used in Boston. A key was used to strike the several numbers by hand, but the operator sometimes made mistakes. In 1854, a young Englishman, Mr. E. C. Clay, who worked in our shop, patented an improvement by which, after setting a dial, the signals were given automatically. Mr. Clay is still living and his device is still in use, but

he never received a cent for it. My father furnished the cash to take out his patent.

1855 saw the birth of a new epoch in the steel industry, through the invention of Bessemer, who by melting iron in a "convertor" and blowing a jet of air through it produced a new and cheaper kind of steel that is used wherever civilization extends.

And it was about this time that Goodyear's invention of vulcanizing india rubber was made useful for the thousands of articles that are now made of it.

In 1855 the first apartment house in Boston, or French flat as it was called, the Hotel Pelham, was erected, on the corner of Tremont and Boylston Streets.

In 1858 the first Atlantic Cable was laid and messages were sent under the ocean and, at about the same time, people began to ride in sleeping cars. My first ride in one was in 1861, on the New York Owl train. This car had three tiers of fixed bunks on each side and a red hot stove in the middle! Also at this

date a passenger elevator was placed in the Continental Hotel in Philadelphia. The car was "screwed" from bottom to top on a long iron screw; this was safe but painfully slow. To-day some elevators travel at the rate of twenty feet per second. The next passenger elevator was that of the Fifth Avenue Hotel in New York.

I have now arrived at the date where we ourselves can remember the new things and the impressions they made, such as Ericsson's "Monitor" with its revolving turret, and the introduction of iron-clad war ships. Dynamite came in 1867 and oleomargarine in 1868. At this date horse railroads were almost the only means of City transit in our cities and suburbs, and the Broadway "busses" were not discontinued until many years later.

The first horse railroad for passengers that I can find a record of ran from Trenton, N. J., to Bordentown. My father traveled on this road in 1832. On October 19th of that year he records, "At 6 A.M. arrived at the railroad,

four splendid cars were soon in readiness to receive the passengers. The cars have a capacity to carry twenty-four passengers and thirty-six could ride comfortably" (they must have had strap hangers on them), "and each car is drawn by one horse at a rate of speed almost eight miles an hour." This road later became part of the Camden & Amboy Railroad. Also my father notes that the best Hotel in Philadelphia charged $1.25 per day for everything, on the American plan.

Street Transportation

The writer's memory goes back to 1852. At that time Hathorne's Line of red omnibuses ran from Charlestown to the Norfolk House, but many of these busses ran only to Canton Street. For one pull on the strap the coach would stop on the right-hand side of the street, for two pulls on the left. The end of the strap was under the driver's feet and sometimes an excited fat woman would come near dumping him into the street. The little five-

cent silver piece was passed up through the hole to the driver and it was a difficult task for him to drive a pair of horses and handle this small change in zero weather. Often a 6 1-4 cent piece was passed up and the driver would hand back a big copper cent. Horse cars had been running in New York on 4th Avenue to Harlem before this, but there were on Broadway at least ten lines of "busses" making that thoroughfare look like the Strand in London.

The first horse railway in Boston ran from Bowdoin Square to Cambridge in 1854, and the Metropolitan Road to Roxbury was opened soon after and still later the South Boston Road and the Highland Railway, whose cars were painted in Scotch plaid patterns. The last horse car was run in Boston on Marlborough Street Dec. 24, 1900.

Next came the Electric Cars with overhead trolley, about 1890. The Slot system of electrical conduction was first used on Boylston and Beacon Streets, but singularly enough was

soon abandoned, and, at the same time, adopted in New York. It should have been retained here and probably costs no more to maintain in the long run. It was claimed that it could not be operated in winter and would kill horses by electric shocks, but neither of these incidents have been observed in New York. Next came the "Elevated" system. Here, New York was ahead of us, but in Subways Boston was the pioneer and New York called on our Mr. George S. Rice of Newton Centre to go there and engineer their tunnels. Motor "busses" are also running in New York, thousands in London, and a few in Boston, so in sixty years the whole system of street transportation has been changed three times and completely revolutionized.

In the early seventies, Prof. Alexander Graham Bell, who was teaching lip-reading to the deaf and studying the acoustics of human speech, began to experiment in transmitting sound vibrations over wires by means of electric magnets with vibrating armatures in front

of their poles. In 1876, he exhibited at the Philadelphia Exposition a telephone line one hundred feet long, over which I talked, and words could be plainly heard, and later he was able to talk over a mile of wire, strung around a room, but naturally this convinced no one that the telephone was an instrument of practical value. It was necessary to demonstrate that it could transmit audible speech from one town to another.

Mr. Charles Eustis Hubbard, a relative of his wife, was at that time a Director in the Walworth Mfg. Co. Through him, Mr. Bell obtained the use of a private wire, owned by that Company, which extended from 69 Kilby Street, Boston, to their factory at Cambridgeport; this wire he could use at night for his experiments. On October 9th he gave a practical demonstration to the Reporters of the *Daily Advertiser*, stationed at each end of the line, Prof. Bell at one end and his assistant Mr. Watson at the other in Cambridge. The published report says, "The sounds, at first faint

and indistinct, became suddenly quite loud and intelligible. Notes were taken of what was said and heard and the comparison of the two records showed the accuracy of the electric transmission."

Then followed a long conversation in parallel columns, as sent and received, proving the fact of transmission of audible speech without difficulty between Boston and Cambridge. This demonstration by Prof. Bell was the birth of the telephone as a practical device, but even then no one had any conception of its future and it was very difficult to persuade any one to invest money in the invention, but those who wisely seized the opportunity became very wealthy. The writer was at this time, among other duties, in charge of this wire, so that he can say, "all of which I saw and part of which I was."

The day of hand fire engines is within our easy recollection. Perhaps as boys we have "run with the old machine," or manned the brakes at a fire. What was more exciting for a boy?

I have seen the hand "tubs" race down the hill on Cambridge Street, Boston, and I tell you they were "going some." A steam fire engine invented in 1854 by Moses Latta and built by Miles Greenwood in Cincinnati was exhibited on the Common about 1857, while the writer was attending Boston Latin School in Bedford Street. It sucked water from the frog-pond and was considered a great wonder. It could throw two streams at once and keep it up as long as coal could be provided for the boiler. This was the first *successful* steam fire engine.

The first practical typewriters seem to have been made by the Remington Company. I have a circular saying that after making many experiments they had constructed one hundred standard machines and had them in actual service in business houses. The reports were so satisfactory that they decided to make up 1,000 machines and place them on the market. Circular shows a table complete with instrument. Price named is $100.

The word typewriter seems to have been then originated, which term is now a little ambiguous, being applied to the operators as well as the machine. One woman is said to have had a fit when she overheard her husband say that he had a new little typewriter that he could hold in his lap.

Electric Telegraph

This invention is especially deserving of mention in this paper, as it actually was born in 1844, when the first practical line was built, although it was conceived some few years earlier.

Samuel F. B. Morse was born in Charlestown, Mass., April 27, 1791, a son of Rev. Jedediah Morse, D.D., a distinguished Congregational clergyman and religious leader, a founder of Park Street Church, Boston, and a Yale graduate. Morse, the inventor, graduated at Yale in the class of 1810. He studied Art both in this country and abroad, and became an eminent artist, being chosen first President of the National Academy of Design

in 1826. In 1827 he made the acquaintance of Prof. T. F. Dana, a fellow-lecturer (on Physics) of the University of New York, and became interested in the subjects of electricity and magnetism, whose identity had just been proved. On his second return voyage to the United States in 1832, he conceived the idea of using an electro-magnet to record messages over a wire. Prof. Dana brought the first electro-magnet to this country and Morse was able to experiment with this instrument, which device is now used on every telegraph line in the world. Many of Morse's fellow-passengers on the steamer substantiated later, in court, his statements about his invention. In 1837 Morse showed an experimental apparatus at Yale College and in 1838 took it to Europe, but could interest no one. England refused a patent and France gave him a useless "Brevet." He returned to America and in 1842 petitioned Congress for a grant to build a line to Baltimore. After he had despaired of obtaining this, in the last hour of the ses-

sion of March 4, 1843, his bill was passed.

His first idea was to place the wire underground, but this proved impracticable, and he built his line with poles and overhead wires and insulators, just as lines are constructed to-day. The construction of a line to Baltimore was immediately begun. The first message was sent from Washington May 27, 1844, so that this wonderful invention, which revolutionized the transmission of intelligence all over the world, well deserves a place in the annals of the 1844 Club.

Very soon the line was extended to Jersey City, and, in a few years, all the cities in the United States were connected by telegraph lines.

The reliability and simplicity of the Morse system was such that it gradually took the lead, and is now used, not only in the United States, but in every country in Europe, and yet the "Encyclopaedia Britannica," in its article of many pages on telegraphs, only gives one line to Professor Morse.

One of the writer's classmates at the Boston

Latin School was a delicate looking boy by the name of John Trowbridge. He graduated at Harvard in 1865, became an instructor and afterwards a Professor. By using a magnet telephone, he made, in 1880, a very elaborate investigation of the propagation of electric currents through earth, water and air. He showed that signaling could be carried on over considerable distances without wires by the humming of the telephone detector placed in the induced current, and suggested that the method be applied to the inter-communication of ships at sea. In 1882 Graham Bell, with boats on the Potomac River, sent signals a mile and a half without wires. In 1891 Trowbridge discovered another method by means of magnetic induction between two separate and completely insulated currents. Willoughby Smith and Sir W. H. Preece experimented in the same line and actually sent messages across the Solent to the Isle of Wight during a failure of the submarine cable. This was in 1882.

But all the later systems and inventions are

based on Hertz's investigation of the Hertzian waves. These waves are produced at one wireless station and detected at another. The detection is based on the discovery that a tube of metallic filings, closely packed, was responsive to electrical sparks made five hundred yards away through Hertzian waves.

This Hughes Detector, as it was called, proved to be far more sensitive than any of the others.

In 1890, Branby described the fact that an electric spark at a distance had the power of changing loose aggregations of metallic powders from poor to good electric conductors, from a very high resistance to that of a few ohms.

In 1894, Marconi began to study devices for the detection of electric waves and invented a new and very sensitive coherer, and discovered that if one terminal of the coherer was connected to a metallic plate buried in the earth, and the other to a series of aerial wires, which are called antennae, he could de-

tect very feeble Hertzian waves made at a great distance. This combination forms the basis of all wireless telegraphs. The messages are sent by pressing down a key, sending a current through a very powerful inductive coil, for a longer or shorter time, and sending a torrent of electric sparks between two spark-balls, alternately charging and discharging the elevated wires. At the receiving station there is a simple voltaic cell and a sensitive telegraphic relay in series with the tube of metallic filings. The relay actuates through a local battery, an ordinary Morse printing telegraph instrument, which records the message. The whole apparatus is now so simplified that mere lads are using it for their own entertainment, to the confusion of some legitimate operators. It is necessary that the little tube should be tapped, after each electric charge, by light blows on the underside, to render it non-conductive; this is done automatically by a connection with the Morse relay instrument; thus are made the dots and dashes that spell

the words in letters of the Morse alphabet.

In 1895 this system was used between Bournemouth, England, and Alum Bay, a distance of 14 1-2 miles. In 1899 communication was used between England and France, sending twenty to fifty words per minute. In 1901 messages were sent 200 miles. In 1902 it was the writer's privilege to have the working of the apparatus on the Cunarder "Saxonia" explained to him by Prof. Trowbridge himself, really the first experimenter in sending messages without wires.

In 1906 regular service was established from Ireland to Cape Breton, and lately messages have been sent from Washington to Honolulu; and now the same systems have been adapted for telephoning and people talk without wires from Chicago to Boston and San Francisco.

This year of 1914 will be long remembered as the date of the Pan-German War. The military operations have demonstrated the extraordinary changes in the science of warfare during the last seventy years. We hear for the first

time since the advent of civilization the "gospel of frightfulness" preached. The unspeakable barbarism and cruelty of the apostles of the new Kultur, the deliberate drowning of thousands of women and children, the wanton destruction of the homes and household goods of poor peasants to no advantage to the aggressors, the harrying into servitude in the enemies' country of thousands of laborers, and the carrying away of the young girls, the whole constituting a chapter of unparalleled horror.

On the physical side of warfare the changes in seventy years have been extraordinary. The war of 1812 was fought with flint-lock muskets six feet long. In 1844 the Springfield Armory was altering the guns of this pattern to the percussion locks used in the Mexican War. In the war of the rebellion the rifled Springfield muzzle-loader was our arm, although breech-loaders had been invented and many "Sharp" rifles and others were used before the end of that war: also the Colt revolver had come into almost universal use.

The Franco-German War of 1870 marked the substitution of breech-loaders for muzzle-loaders, needle-guns by the Germans and Chassepots by the French; also the use of rapid-fire machine guns and mitrailleuses. In our Spanish War we used the Krag-Springfield rifle, which pattern, modified and improved, is used by the United States to-day, while the English are using the "Enfield," which takes the same ammunition. The army rifle of to-day is of about half the weight and half the length of the musket of 1844; it fires a small bullet, shaped like one-third of a lead pencil, five times as far, and will bore a hole through a file of five men, and it uses smokeless powder. In artillery equal improvements have been introduced, and for trench warfare hand-grenades like those of 150 years ago are used. The Germans have also introduced the new horrors of blinding poison gas, and the Zeppelins that drop bombs on peaceful homes.

It is a pity to close this paper with such a tale of horror marking our seventieth year.

Let us hope that the children born in 1914, when they sit down to their anniversary dinner in 1984, will be able to say that there will be no more war but universal peace "per secula seculorum."

D. H. Andrews
Sep. 17th 1844.

Notable Events in Engineering Progress During the Past Seventy Years

SO far as can be learned the title of Engineer originated with the early development of the skill of individuals in designing building and operating so-called engines of ancient warfare, and engineering was primarily of a military nature.

When civilization had so far progressed that the wants of mankind demanded the application of engineering skill to the designing and production of works of public and private utility, the term of Civil Engineering began to be applied to all other engineering developments in distinction from military engineering.

Civil Engineering, when the Institution of Civil Engineers was formed in London in 1828, was described as "the art of directing great resources of Power in Nature for the use and convenience of man." The description went

on to enumerate many of the methods of application of engineering study and skill, ending with "the construction and adaptation of machinery." Though a broad one for that day, the enumeration falls far short of the fields occupied and served by the engineers of to-day.

Later on, in the nineteenth century, a gradual specialization set in, and so far as known the first branch to be recognized as separate was Mechanical Engineering, which is concerned with the design and production of machinery of all descriptions.

Soon engineering especially devoted to the development and operating of mines became Mining Engineering. Subsequently other subdivisions came into existence, such as Marine and Naval Engineers, Chemical Engineers, Hydraulic Engineers, Railway Engineers, Sanitary Engineers, the modern Electrical Engineer and, at last, the still more modern Efficiency Engineer.

Leaving out the last entitled subdivision which should, perhaps, be adjudged a mis-

nomer, engineering of to-day signifies in a broad way the art of turning to practical benefit the powers and utilities which exist in nature.

The accomplishments which, during the last seventy years, stand accredited to the Engineering Profession, are very numerous, highly interesting and of enormous progress, and it would be difficult, if not impossible, to determine the most far reaching of these accomplishments.

Zoology, after the most analytical comparison of man with other animals, used to say that the final and distinctive difference between man and other animals is articulate speech. Whether or not that distinction remains true, it will be conceded that human intercommunication is one of the greatest factors in the progress of mankind. Hence, the engineering accomplishments which contribute most to facilitate such intercourse attract first attention.

Among the high engineering accomplishments of this order stands the establishment and growth of the Railway. Although tram-

ways with tracks of some sort to support and in some instances to guide the wheels for wagons propelled by animals or human beings existed as far back as the middle of the sixteenth century, it was not until 1804 that the first attempt was made to propel vehicles by steam upon trams laid down for the wheels. This early effort proved a failure and the effort was abandoned.

In 1814 George Stevenson's first steam locomotive, the "Blucher," drew a train of eight wagons at the rate of four miles an hour and in 1821 the English Parliament authorized the building of a thirty-eight mile railroad for horse propulsion. This railroad was opened in 1825 and by Stevenson's advice Steam Locomotives were adopted, but they were only hopeful forerunners of the locomotive to come.

The first attempt to build a steam railroad in this country was by the Delaware & Hudson Canal Company when, in 1828, it decided to build a railroad sixteen miles long and purchased in England three locomotives, the first

of which to arrive here was the well-known "America."

The first locomotive made in America was the "Best Friend," built by the West Point Foundry, New York, and it was completed in 1830, and following this the first locomotive to have a pair of driving wheels under the fire box and a pair of carrying wheels under the smokestack was completed but ten years before the unheralded but momentous arrival of the founders of the Forty-four Club.

In 1840 the mileage of steam railroads in the United States was only 9,015 miles and in 1908 the mileage was 236,949 miles and that of the whole world was 601,808 miles.

The building and mechanical equipment of all these miles of railroad, involving huge hill cuttings and valley embankments, the tunneling of mountains, the bridging of great rivers, the conception and building of vast terminal facilities, the improvement of cars from the small four-wheeled wagons to the steel freight car carrying its 100-ton load, and

from the crude box passenger coach to the luxurious Pullman parlor and sleeping cars, constitute a brilliant galaxy of engineering achievements, practically all of which have been accomplished within the last seventy years.

The great invention by George Westinghouse of his straight compressed air brake in 1869 quickly followed by his automatic air brake in 1894 enormously contributed to human safety and made possible the running of very high speed trains.

The telegraph with its enormous usefulness was foreshadowed in 1753 when theoretically, but without practical application, it was proposed to convey messages by means of as many wires carrying electric currents as there are letters in the alphabet, and words were to be spelled by passing the electric current through each wire as the indication of each appropriate letter was desired, the charged wire being indicated by various methods suggested.

It was not, however, until S. F. B. Morse in 1835 perfected a model by which an alphabet

consisting of letters indicated by long and short occurrences of an electric current that practical communication by the telegraph was accomplished and the world was given seemingly unsurpassable human intercourse.

Nevertheless, this accomplishment was far surpassed when Alexander Graham Bell in 1876 invented the telephone. This invention was undoubtedly suggested by the fact, well known in the time of our childhood, that conversation can be carried on by persons, quite distant from, and out of sight of each other, by means of a string stretched across the interval, each end of which is attached to the bottom of a tin can, the other end of the can being open. The can bottoms acting as diaphragms receive the sound vibrations at one end and give them out again to the listening ear at the opposite end.

The telephone transmits the sound waves by means of a conducting wire charged with electricity and joined at its opposite ends to thin steel diaphragms in such a manner that

the sound waves received by one diaphragm so modulate the electric current that the same waves are reproduced in the opposite diaphragm, and the most subtle variations of sound are audible. The whole civilized world is now covered with a network of telephone wires, so that men converse with each other, though hundreds of miles of separation intervene.

This achievement would seem to be climactic; but no—human ingenuity has recently given us wireless telegraphy by means of which intermittent groups of electric waves sent out into the air are intercepted by appropriate instruments hundreds and even thousands of miles away, and ships widely separated upon the sea converse with ease and in distress call succor from afar.

We await now the acme of human intercommunication when some inventive wizard shall enable us to see each other through a wire a thousand miles stretched out.

The almost universal substitution of soft

steel for wrought iron constitutes one of the greatest engineering accomplishments of the past fifty years. Wrought iron, so-called, is made from pig iron by the laborious hand process called puddling, and its tensile strength and other qualities are ordinarily much below those of soft steel.

Sir Henry Bessemer in 1854 began an attempt to improve metal for the manufacture of artillery and in 1856 made public his invention, which by means of a blast of air through molten pig iron decarbonized it and produced soft steel. This invention caused the complete substitution of soft steel for iron railroad rails, greatly enhancing both their strength and durability.

This invention has also resulted in the substitution of soft steel for iron in all cases where the particular qualities of iron for welding and forging are not requisite and has contributed enormously to the growth of great steel structures, such as the modern skyscraper buildings, huge bridges and other utilities.

In 1867 Sir William Siemens, an English engineer and inventor, brought out what is called the open hearth process for producing mild or soft steel. This process produces at a slightly higher cost a steel of greater uniformity and reliability than the so-called Bessemer steel, permitting the manufacture of steam boilers able to carry with safety vastly higher pressure and of much higher efficiency than formerly. The most advanced railroads are now ordering all their rails to be made of this open hearth steel and all railroad bridges are made out of it.

A sewing machine, in very crude form, was invented in 1830 by a Frenchman, but although the inventor labored upon it until 1857 he died unsuccessful and unrewarded.

Walter Hunt in 1834 constructed a sewing machine having a curved needle with an eye near the point and a stitch was formed by an oscillating shuttle, but no patent was attempted until 1853 and then it was disallowed. The needle with an eye near the point, the basic

necessity of all sewing machines, was patented in 1841 by an Englishman.

All this was unknown to Elias Howe of Spencer, Mass., who in 1846 patented the first lock stitch sewing machine. Howe was unsuccessful and sold out his English patent to an English corset manufacturer for 250 pounds and was so poor that he pawned his American patents; but he finally recovered his American patents and was successful in litigation with Singer and others, and as a result all the sewing machine manufacturers became tributary to him and he was amply rewarded. Following Howe with patentable improvements were Singer, Isaac Merritt, Wheeler & Wilson, Grover, and Wilcox & Gibbs, and the sewing machine has become such a necessary factory of human welfare and the cost of its production by engineering study and practice so greatly reduced, that a home to-day without a sewing machine is a rare exception.

The perfection of the cloth sewing machine seems to have excited a demand for machine-

made shoes in which the most difficult operation is the attachment of the sole to the uppers. This attachment was formerly all accomplished by hand and though sewing was extensively used, the largest number of the soles were attached by some form of wooden or metallic pegs. The first successful machine for sewing on the soles of shoes was invented and patented by Lyman R. Blake in 1858, but his machine would not sew around the toe.

In 1860 Gordon McKay, in conjunction with Blake, effected important improvements and protected them so successfully by patents that they effected a practical monopoly in sewing machines for shoemaking.

For a short time this discouraged invention, but in 1862 August Destory invented a machine for sewing soles to the welt, which was afterward perfected by Charles Goodyear, a son of the celebrated inventor of rubber vulcanization. Improvements thereafter continued, until now not a single hand application is required to manufacture the best and most

comfortable leather shoe the world has ever seen.

Discoveries respecting electricity and magnetism date back to scanty knowledge by the ancients; and it is said that 600 years before Christ it was known that amber, jet and a few other substances had the power, when rubbed, of attracting straws, feathers and other substances. One Gilbert in 1600 made for himself a name by publishing the first study of magnetic attraction. Many ingenious students of electrical phenomena discovered various properties of electrical and magnetic functions, for which they obtained lasting credit. Among these was Volta, whose chemico-electrical discoveries in 1799 have resulted, in conjunction with the additional efforts of others, in producing those batteries which generate electricity by chemical dissolution, like the ordinary zinc, carbon and sal ammoniac battery. But the most important discoveries, forecasting the developments which have produced the modern generator and motor, are unquestionably due

to Faraday, who in 1831 discovered the fact that magnetic lines of force are constantly passing between adjacent and opposite magnetic poles, and that by revolving an electric conductor across the path of these lines and thereby cutting them an electric current is generated. This is the parent thought in all mechanical electric generators to-day. He also discovered what is called electro-magnetic rotation, another fundamental basis of modern electric practice.

Faraday's copper disk rotating between the poles of a magnet interested many minds in efforts to perfect apparatus, so as to generate electricity for commercial use. Faraday's single copper disk generated direct current electricity at a very small voltage and though much time and very large expenditure has been devoted to the effort, no generator producing direct current electricity in its armature has yet been successfully put into commercial use.

The first practical dynamo or generator was

constructed by Seamens & Wheatstone in 1866 and it was used for arc lighting, which Sir Humphry Davy had experimentally demonstrated the possibility of in May, 1808.

In 1870 Z. T. Gramme invented the improved armature winding which resulted in the present commercial alternating current armature, and it was soon discovered that a dynamo of the Gramme type would also run as a motor, and electrical transmission of power had its birth.

One of the most interesting and important achievements of modern electrical engineering was the discovery of electrical accumulation or storage, so-called.

In the year 1801 Gauthorot discovered that two plates of the same metal immersed in diluted acid, after having been subjected to the action of an electric current in one direction, would produce, when the conducting wires were reversed by attachment to the opposite terminals, a current of electricity in the opposite direction. No practical result followed this

discovery until in 1859 Gaston Plante after elaborate experiments discovered that a lead sulphuric acid cell would retain for a long time after charging the power to give off an electric current. For many years it was believed that the generated electricity was actually stored in the battery cells, but it is now well known that the electric current through the cells causes an electro-chemical decomposition which produces in the elements of the cells such a condition that when the conducting wires are disconnected from the generator and reversely attached to the terminals of the cells, a reverse electro-chemical action is produced which regenerates electricity in the opposite direction from which the electricity passed into the cells. The studies and experiments of eminent modern electricians, including our own Edison, have produced storage batteries of immense importance in the field of electrical engineering, and they are in extensive practical use. The great function of the electric storage battery is its ability, for quite a period of time after it is

charged, to produce an electric current by the turn of a switch, the storage battery being removed to any desired location.

Another important function is its ability to deliver a perfectly uniform current of electricity which cannot be done by any generator now in commercial use. It will be recalled that when the telephone was first introduced scratching sounds almost fatally disturbed transmission of speech. This was due to lack of uniformity in the current received directly from a generator and the defect was entirely cured by the use of storage battery current.

Electric lighting was first confined to the light from the electric spark itself, passing across the open space between two electrodes. It was, in the experimental stage of electrical study, an unavoidable discovery, that electricity in an overcharged conductor produces heat. This led Edison and others to confine a minute and highly overcharged conductor in a transparently enclosed vacuum, so heating without destruction the conductor to a high

state of incandescence and thereby producing the well-known incandescent lamp. All are familiar with the vast application of electricity to the propulsion of street and other railway cars and to the running of machinery of every description; but there are less conspicuous though very large fields where its application has produced marvelous results, like electro-chemical separations, electro-metallurgical operations like the production of aluminum and electrolytic copper, electro-mineral formation, like the production of carborundum and other abrasives. It may safely be said that no generation has ever witnessed a greater development than that which has been accomplished by electrical engineers within the last fifty years.

In 1794 an Englishman by the name of Street took out a patent for an internal combustion engine, vaporizing spirits of turpentine for his gas. The engine was impracticable and never came into use. Various attempts in the same direction followed, and William

Barnett in 1838 was the first to compress the gas in his cylinder before exploding it, and a Frenchman, E. Lenoir, in 1860, was the first one to produce an internal combustion engine of which any number were built for use.

The commercial history of the internal combustion engine begins with the inventions and patents of Dr. N. A. Otto, a German engineer, in 1876. The Otto gas engine has had a large commercial use, where comparatively slow speeds are required and weight and size are not a handicap.

In 1883 Daimler conceived the idea of producing a light engine to run at 800 to 1,000 revolutions per minute. In 1886 he made the first motor cycle and in 1887 he had completed and operated the first gasoline motor car. He used a carburetor and water-jacketed his cylinder, and the gas was ignited by means of an igniter tube, which was so arranged that at the proper intervals it was fired by a constantly burning lamp. The igniter tube was soon superseded by igniting with an electric

spark from a battery and later with a spark from a small high tension magneto.

From this practical beginning only thirty years ago sprung into being the modern motor carriage of to-day, which is now built to supply the humblest and the most luxurious demands and gives transportation to mankind for pleasure, business and traffic in every country on the face of the globe, and it has caused the establishment of an incredibly vast manufacturing industry. The modern gasoline engine alone has made aviation, hitherto the shadowy dream of enthusiasts, not only possible but practicable, so that man now soars above the clouds and in his flights is the rival of the birds in speed, if not in space o'erflown.

During the past seventy years the progress in Metallurgical Engineering has been steady and of large importance and especially as it has affected Structural Engineering. At the beginning of that period wood, brick, stone and mortar, cast and wrought iron, were the principal materials used in structures and the

magnitude of buildings, bridges and other structures was limited to the strength of those materials. Iron in the form of castings, with comparatively small tensile strength, and so-called wrought or puddled iron, were the two principal metallic elements available for structural forms. The commercial method of producing steel was the so-called crucible process, by means of which steel capable of being hardened or tempered for the use of tools and cutting instruments was and still is made. Such steel is unsuitable and also too costly for use in building bridges and other large structures. Wrought iron was the only available material for railroad rails for many years after railroads came into use and though made by the best methods known, these rails would stand the traffic of the light locomotives and cars then in use but a short time.

In 1856 Sir Henry Bessemer invented his process of making soft steel by means of a blast of air through molten iron. The process being comparatively inexpensive and capable

of almost unlimited production, the manufacture of this steel soon greatly increased. It was quickly substituted for iron in railroad rails and on account of its superior strength soon gave a great impulse to the building of structural frame and truss work of enormous dimensions.

In the years 1865 to 1867 Emile Martin and C. W. Sieman developed the new method of making soft steel, called the open hearth process. In this process the metallurgical character of the changes proceeding can be observed and controlled more closely than in the Bessemer process and the result is a metal much more uniform and reliable. In addition to these two vastly far-reaching improvements in the production of steel, very great increase of strength for specific uses has been secured by alloying with it nickel and other ingredients.

Seventy years ago all trusses for bridges were built mainly of wood, many of them having no iron members. A Mr. Howe, for whom his form of truss was named, was the first to

use iron to any extent for the vertical members, and many so-called Howe bridges are still in existence. One of the most notable bridges using Howe wooden trusses was the Pennsylvania R. R. bridge over the Susquehanna River at Havre de Grace, built about 1840 and since replaced first by an iron bridge and later by a steel bridge.

The substitution of iron and steel for wood in the trusses and arches of bridges began in this country after the close of the great Civil War and the modern steel frame building had its inception in 1881 in a steel cage building in New York City, the walls being filled in with masonry. Subsequently, this form of steel frame building was brought extensively into use in Chicago and from thence spread to all parts of the country. From these comparatively recent beginnings steel bridges and buildings of colossal proportions are now of common occurrence.

As time failed the author of the epistle to the Hebrews "to tell of Gideon and Barak,

of Samson and Jephthae, of David also and of Samuel and all the prophets," so time fails us to tell of the wonderful engineering achievements of the Panama Canal and of its satellite, the Cape Cod Canal; of the improvement in farming implements and machinery; the ingenious devices for textile figure weaving and knitting; the great development in machine making tools and the multitude of other contrivances of engineering skill wrought out in the last seventy years; and we must regretfully bring to a close this partial consideration of remarkable engineering achievements, largely accomplished during the lives of the members of the Forty-Four Club.

D. H. Andrews.

J. R. Leeson.
July 8, 1844

Retrospect

PERUSAL of the foregoing papers written on the writer's suggestion by co-members of the Forty-Four Club confirms the wisdom of such request. My extreme good fortune will be generally admitted in having as near neighbors such estimable contemporaries as Messrs. Walworth, Andrews and Dr. Huntington. Moreover, there will undoubtedly be full acquiescence in the idea of using these papers, read at the first regular meeting of the Forty-Four Club, as a permanent memento of the occasion.

In addition to the remarkable expansion shown by Dr. Huntington in educational progress, and by Mr. Andrews and Mr. Walworth in engineering and mechanical development, the period 1844-1914 was noteworthy in the domain of politics and economics.

Noting a few of the leading events, it may be recalled that during the seventy years there

was in various parts of Europe and elsewhere a quickening of men's minds shown in insistent demands for greater freedom in mental, moral and physical aspects of human endeavor.

The French Revolution of 1848 recurs, the struggles in Hungary, and the emancipation of Serfs in Russia from soil slavery and Vodka. Nearer home, the series of revolutions in Cuba, culminating in the action of the United States in aiding Cuba, Puerto Rico and the Philippines to rid themselves of Spanish domination, is remembered.

Possibly no event of the period has had more far-reaching effects than our civil war, involving abolition of slavery in the United States, following total abolition of forced labor in all British dominions, as well as the end of the atrocious slave traffic in Africa.

The acquisition of the Philippines, Puerto Rico, Hawaii, Guam and the purchase of Alaska have, many are beginning to see, changed the policy of our country, involving participation in world affairs. Such a development

could hardly have been foreseen or realized in the earlier stages of our own career.

The opening of Japan to the Western world, and her recognition by the Treaty of Portsmouth as one of the Great Powers, the transformation of China from the control of a Manchurian dynasty to a Republic, are worthy of note.

Two of the most momentous political changes were consolidation of the several independent States in Germany into one united empire, and the unification of Italian States under the masterly direction of Cavour and those working with him. The seizure by Germany of Alsace-Lorraine and Schleswig-Holstein, should not be overlooked. The last named is of especial interest to us, inasmuch as it was from that region that many of the original emigrants went to what was then Britain, and, after overcoming the Roman power in Britain, established government in England, laying the foundation of that type of civilization which, being subsequently brought across

the Atlantic nearly one thousand years later, made possible our Republic.

In economics, the growth of the corporation into control of large business and the increase in the use of minerals; construction of the world's four great canal systems, Suez, Kiel, Panama and Manchester Ship Canal, was followed nearer home by the opening of our own canal across Cape Cod.

Development of anaesthesia and antiseptic surgery, germ theories, serum treatment, deadening pain, increasing human comfort, and adding to the span of life, are vital accomplishments of our era.

It was in this period also that the North and South poles were, so far as known, first visited by man, and at the end of our seventy-year span was begun the most terrible conflict the world has known, demonstrating a barbarism and inhumanity among the Germans hitherto unsuspected, but now recognized as the consequence of a generation absorbing an immoral philosophy which disregards the pre-

cepts of law, both human and divine. While this fearful struggle is unique in extent of destruction of life and material things, it is the hope of the Forty-Four Club, that, dreadful as the events of the war have been, the overruling Spirit which has created us all may, in His own good time, bring order out of chaos, and thus continue the progress of humanity toward that more perfect life to which all aspire.

J. R. Leeson.